

Integrated hypertension management and national hypertension discipline promotion in China

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Cardiovascular diseases (CVDs) are currently the leading cause of global health loss, accounting for one-third of deaths worldwide^[1] and estimated to cause 7.8 million premature deaths in 2025.^[2] Hypertension is the top preventable risk factor of CVDs globally and in China.^[2,3] Conservative estimates indicated that the national economic loss due to CVDs in China can reach \$8.8 trillion over 2012 to 2030.^[4] Hypertension treatment in Chinese adults aged 35 to 84 years was analyzed to reap savings later for around 800,000 CVDs events prevention annually and improved the quality of life and economic productivity.^[5] In 2010, an estimated 1.39 billion people worldwide affected hypertension but only one in seven patients under blood pressure (BP) control.^[6] In comparison with hypertension management programs successfully performed^[7,8] in high-income countries and substantially increasing hypertension control rate, disparities remain between hypertension burden and control rate in low- and middle-income countries.^[6] The recent China Hypertension Survey (2012–2015) recruited a nationally representative sample of 451,755 residents aged ≥ 18 years from all 31 provinces in the mainland of China, observing that 23.2% (estimated 244.5 million) and 41.3% (estimated 435.3 million) of the Chinese adult population had hypertension and prehypertension, respectively. However, the rates of awareness, treatment, and control were only 46.9%, 40.7%, 15.3%, and even decrease according to the 2017 ACC/AHA guideline.^[9,10]

Multiple factors may contribute to the poor hypertension control rate in China. First, disparities on medical resources among diverse-level medical centers and immature health care delivery system for hypertension management limit systemic treatment and control for hypertension. Even among different provincial or prefectural level medical centers, hypertension discipline

construction process and evaluation criteria are biased. In addition, awareness and capacities for hypertension screening, treatment, and control at primary care centers are limited, whereas incentives and trainings for primary care providers are particularly lacking, leading to hurdles on implementation of hypertension patient management. Also, issues on antihypertension medications are significant, including unaffordable, inconsistent medication supply, and unreasonable treatment algorithms at primary care centers with a few antihypertensive combination therapy and limited use of single-pill combination (SPC) treatment. Lastly, hypertension patient adherence and public concern on health promotion are unsatisfying. Nationwide efforts are therefore urgent to promote hypertension management, particularly, on building discipline capacity and strengthening the integrated healthcare system for hypertension. The main objectives include: (1) advancing and generalizing the guideline based screening, diagnosis, and treatment of hypertension, for both primary and secondary hypertension; (2) promoting regularly standardized trainings, continuing education, and intellectual resource cultivation on hypertension discipline; (3) constructing National Medical Alliance for Hypertension (NMAH); (4) developing comprehensive mode of hypertension patient management; (5) reinforcing patient education, improving public awareness and patient adherence of hypertension management; and (6) advancing scientific researches in hypertension field.

Specialized hypertension discipline promotion requires multidiscipline collaboration, such as cardiology, nephrology, endocrinology, neurology, vascular surgery, urology, psychology, and genetics. Backup system construction is also required of hypertension screening, diagnosis, and treatment, including: (1) laboratory examinations for

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primary and secondary hypertension, such as levels of renin, aldosterone, and catecholamines; (2) vascular function evaluation, such as endothelial function test (flow-mediated dilation), pulse wave velocity, and ankle-brachial index; (3) imaging examinations, such as adrenal computed tomography, metaiodobenzylguanidine scintigraphy, renal arteriography, and adrenal venous sampling; (4) sleep respiration monitoring or polysomnography, utilized for obstructive sleep apnea syndrome evaluation; (5) renal biopsy and pathological examination, assisting etiology diagnosis of renal hypertension; (6) minimally invasive surgical and interventional techniques for hypertension therapy, such as renal sympathetic denervation and laparoscopic adrenal adenoma resection; (7) genetic diagnosis, identifying monogenic hypertension and guiding individualized medication treatment based on pharmacogenomics; (8) mental state evaluation, such as questionnaires of self-rating anxiety scale and self-rating depression scale; and (9) novel techniques for hypertension diagnosis and treatment, such as digital transformation and artificial intelligence.

In terms of specialized hypertension center construction and discipline capacity advancement, the “Chinese Hypertension Center Certification” project was initiated on October 4, 2018, authorized by the Specialized Committee for Hypertension of Chinese Medical Doctor Association, the National Center for Cardiovascular Diseases, the Chinese Society of Cardiology, and the Specialized Committee for Hypertension of Health Exchange and Cooperation Across the Taiwan Straits. Five sections with 83 detailed standardized criteria were established for the “Chinese Hypertension Center” assessment. Core criteria contain: (1) organization construction (25%), including infrastructure construction of hypertension clinic or ward, expert committee establishment, and medical equipment; (2) standardized diagnosis and treatment for primary hypertension (25%); (3) screening, diagnosis, and treatment for secondary hypertension (20%), such as causes of renal diseases, primary aldosteronism, pheochromocytoma and paraganglioma, Cushing’s syndrome, renovascular stenosis, aortic coarctation, and obstructive sleep apnea syndrome; (4) guidance for hypertension management capacity-building at primary care centers (20%). For instance, hierarchical medical system construction (local Medical Alliance for Hypertension with dual referral systems) and trainings for primary care providers are mainly concerned; and (5) capacity for hypertension research (10%). By October 2020, 40 province-level centers [Supplementary Table 1, <http://links.lww.com/CM9/A959>] have been certificated as “Chinese Hypertension Center” after the process of registration, initiation, online application (<http://gxy.nccd.org.cn>), initial audit online, site audit, and voting. The annual material update is obligatory of the certificated center for surveillance and evaluation.

In addition, the NMAH, a national collaboration network for standardized hypertension diagnosis and treatment, capacity-building of healthcare systems for hypertension, and efficient hypertension management, was initiated on November 25, 2017, guided by the National Health Commission of the People’s Republic of China, and

authorized by the National Center for Cardiovascular Diseases. The NMAH collaborates multilevel centers or hospitals from all geographically province-level and prefecture-level administrative regions in the mainland of China except for Tibet, incorporating typical Chinese governmental and administrative models with specialized hypertension management and discipline promotion strategies [Figure 1]. By November 30, 2020, NMAH includes 38 province-level centers, 237 prefecture-level subcenters, 7314 registered medical centers (including county, township, or community-level centers), and 35,643 doctors [Supplementary Table 2, <http://links.lww.com/CM9/A959>]. Stepwise guidance for healthcare system strengthening is incorporated. The expert committee of NMAH, consisting of national and provincial hypertension leaders corresponding to the organizing structure of NMAH, has also developed an annual National Hypertension Congress covering about 150 experts and around 1.34 million audiences per time in 2021, and regular doctors’ trainings of 58 training sessions with over 290 expert lectures covering 24 provinces and 287,789 audience per time between February 2021 and September 2021. The standardized training materials include versions for hypertension professionals and primary healthcare providers (ie, National guideline for hypertension management in China [2019]^[11]), and standardized patient education materials (ie, National guideline for hypertension patient education in China [2021]^[12]). Relative materials, training slides, and videos are also updated online into the integrated supportive system of NMAH.^[13] The information platform was designed with digital service Apps for real-time interactions between doctors and patients, online workstations with innovated “Green Channel” for promoting convenient referral and remote consultation via the stepped-up structure of NMAH, a big data center (cloud computing) supporting medical researches for hypertension, and open ports reserved for third-party access, such as BP data automatically uploaded from electronic sphygmomanometers (office, automatic arm-in, and home BP monitors) and artificial intelligence based techniques. Currently, the platform is utilized as an innovative App management model evaluated in the Strategy of BP intervention in the elderly hypertensive patients (STEP) trial^[14] for patient adherence promotion.

On the basis of organizing framework, digital platform, and training materials of NMAH, the “Hypertension Prevention and Control Initiative in China” project (ClinicalTrials identifier: NCT04289701) was initiated on October 8, 2019, authorized by the National Health Commission of the People’s Republic of China, and initiated by the National Center for Cardiovascular Diseases, Fuwai Hospital, Chinese Academy of Medical Sciences. The main objectives of the project are: (1) to explore a feasible and reproducible archetype for hypertension management; (2) to improve the registration, management, treatment, and control rates of hypertension in China; and (3) to improve the management mode of primary chronic disease by taking hypertension as the entry point.

NMAH will consecutively spread 40 county-level medical alliances from 31 provinces for pilot project implementation.

National Medical Alliance for Hypertension

38 Province-level Centers
237 Prefectural-level Sub-Centers
7314 Medical Member-Centers
35643 Doctors

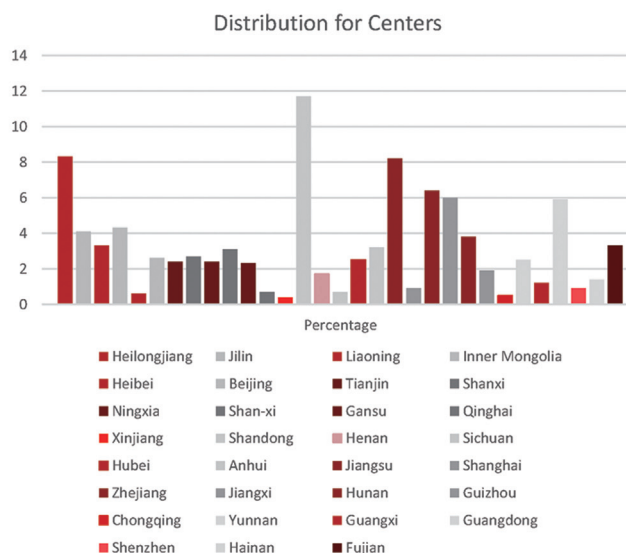
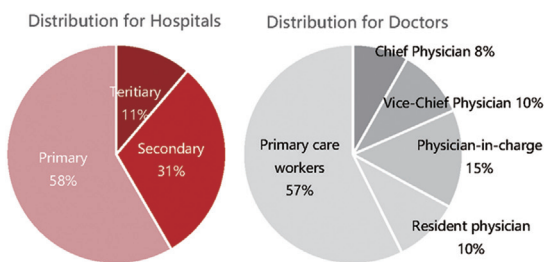


Figure 1: Organizing framework for NMAH. NMAH collaborates multilevel centers or hospitals from all geographically province-level and prefecture-level administrative regions in the mainland of China except for Tibet. By November 30, 2020, NMAH includes 38 province-level centers, 237 prefecture-level subcenters, 7314 registered medical centers, including county, township, or community-level centers, and 35,643 doctors. The distribution of centers, hospitals, and doctors of NMAH is also presented. NMAH: National Medical Alliance for Hypertension.

The local Task Force will then be established on the basis of medical resources, collaborated multilevel structure, and shared information platform from NMAH. The collaboration between the local Task Force and the local CDC, supervised by the local Health Commission, is encouraged. The main workflow for the project includes [Supplementary Figure 1, <http://links.lww.com/CM9/B289>]:

- (1) Regularly online and onsite trainings for healthcare providers. Extending from the experiences of the Canadian Hypertension Education Program,^[8] all our training manuals are based on the hypertension guidelines and translated to simple implementable messages focusing on diagnosis, risk stratification, interventions (majorly lifestyle and pharmacologic), and management for hypertension, anchoring diverse targeted groups and reviewed by the Expert Committee of NMAH.
- (2) Patient-centered hypertension management. All adult hypertensive residents in pilot sites diagnosed according to the Chinese Hypertension Guideline^[15] are eligible to participate in the project. A responsible doctor will be chosen by each patient and conduct “one-to-one” management at primary healthcare centers, after guideline-based risk stratification and transferring high-risk patients to the specialist center via the “Green Panel” of NMAH.
- (3) Simplified hypertension treatment protocol recommendation. The expert committee of NMAH recommends the standardized hypertension treatment protocols based on the Chinese hypertension guide-

lines and key elements of simplified protocols utilized in other successful hypertension prevention and control program.^[7,16] Three independent algorithms, including calcium channel blocker, angiotensin receptor blocker or SPC as first-line therapy, and dose- and category specific antihypertension drugs at each step, can be referred. Affordable, high-quality, and long-term drugs are recommended such as drugs procured from the Chinese national pharmaceutical policy for patients with the minimal price of amlodipine ~\$0.01 per tablet (5 mg), irbesartan ~\$0.05 per tablet (150 mg), and SPC ~\$0.15 per tablet (irbesartan 150 mg and hydrochlorothiazide 12.5 mg).

- (4) Periodical patient follow-up via BP monitor-sharing system equipped with automatically BP data update to ensure real-time monitoring and data authenticity.
- (5) Outcome and performance evaluation. Key outcome indicators include the number of patients registered, under management, on treatment, with BP control, or with the onset of cardiovascular events.^[14]
- (6) Incentives and subsidies. Predecided compensation will be offered to local healthcare organizations for extra healthcare services. In addition to reimbursement, the ranking list of performance for primary care centers will be presented with representative healthcare providers for attending continuing education programs at higher level medical centers via NMAH and for invited lecture at the annual National Hypertension Congress. The project will also provide targeted subsidies to patients through several approaches such as free home BP monitors.

The overall project has a three-step-wedged design consecutively spreading until 2025. By April 23, 2020, the first four pilot sites (Beijing, Heilongjiang Province, Yunnan Province, and Jiangxi Province) have 3251 patients under management with a control rate of ~53% by September 2021. Steps 2 and 3 will integrate with the “Hypertension, Hyperlipidemia, Hyperglycemia Prevention, and Control program” of “Healthy China 2030 plan,” recruiting overall 40 pilot counties covering 31 provinces in the mainland of China.

In essence, we promote multiple projects, including “Chinese Hypertension Center Certification,” “Construction of National Medical Alliance for Hypertension in China,” and “Hypertension Prevention and Control Initiative in China.” Referable models for hypertension management and discipline promotion may herein be developed.

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Conflicts of interest

None.

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